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ABSTRACT

This teacher's guide suggests a number of ways to use a spinning table to explore circular motion. Activities are described which are appropriate for children in kindergarten through third grade. Suggestions are made for exploratory activities using the equipment rather than supplying detailed instructions for formal activities. Equipment and accessories are listed. Suggested activities include ones using chalk, marbles and cubes, powders and liquids, and a plastic tube. Activities are illustrated by photographs. (CS)

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TEACHER'S GUIDE FOR

spinning tables

Elementary Science Study

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the spinning tables unit

TEACHER'S GUIDE FOR SPINNING TABLES
TWO SPINNING TABLES AND ACCESSORIES

Related Units
Drops, Streams, and Containers
Pendulums
Primary Balancing

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preface

The Elementary Science Study is one of many curriculum development programs in the fields of science, social studies, and mathematics under preparation at Education Development Center, Inc. EDC (a private nonprofit organization, incorporating the Institute for Educational Innovation and Educational Services Incorporated) began in 1958 to develop new ideas and methods for improving the content and process of education.

ESS has been supported primarily by grants from the National Science Foundation. Development of materials for teaching science from kindergarten through eighth grade started on a small scale in 1960. The work of the project has since involved more than a hundred educators in the conception and design of its units of study. Among the staff have been scientists, engineers, mathematicians, and teachers experienced in working with students of all ages, from kindergarten through college.

Equipment, films, and printed materials are produced with the help of staff specialists, as well as of the film and photography studios, the design laboratory, and the production shops of EDC. At every stage of development, ideas and materials are taken into actual classrooms, where children help shape the form and content of each unit before it is released to schools everywhere.

acknowledgments

The idea for SPINNING TABLES came to Gerald Wheeler out of the work he was doing in high school physics classes on frames of reference and circular motion. From this austere beginning, the activities were developed with the help of many children and teachers, particularly in the Boardman School in Boston, Massachusetts.

Wheeler took the unit through the trial-teaching stage. Winfield Benner, Anthony Sharkey, Nat Burwash, and Bruno Kansanniva devoted a great deal of time and energy to the design of the equipment.

Adeline Naiman edited the final manuscript, and Nancy Weston oversaw its production. The photographs are by Major Morris and Joan Hamblin.

George E. Hein

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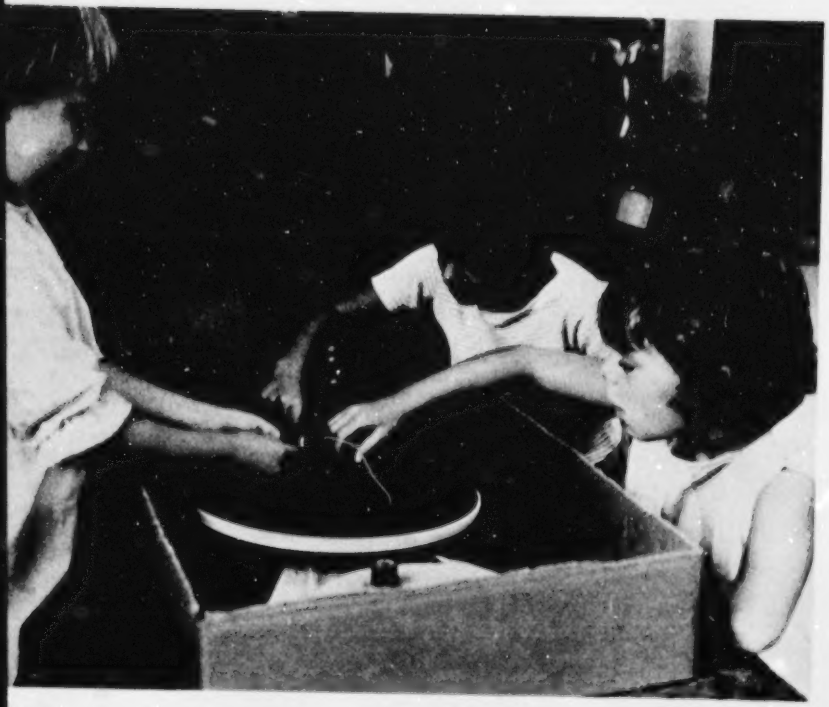
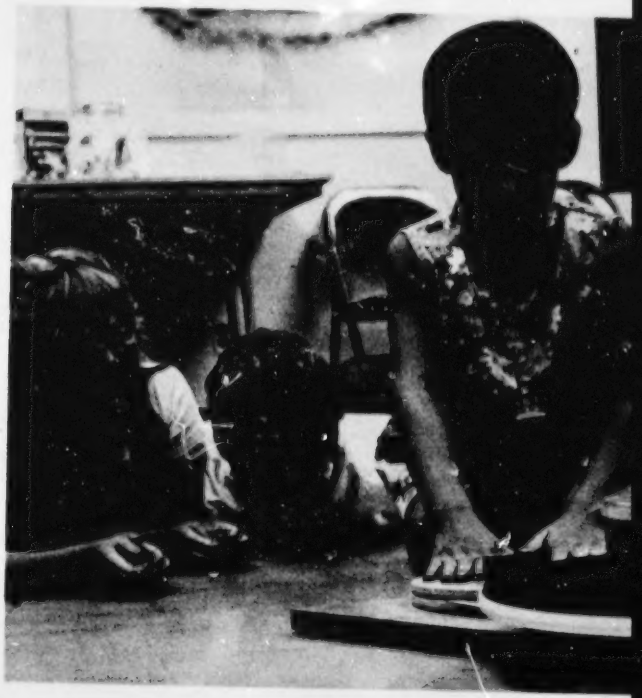




introduction

A spinning table is a simple, manageable piece of equipment with which a child can explore the paradoxical behavior of things that move in circles. Children are familiar with motion in a straight line. They are both delighted and puzzled to find that their predictions about circular motion are often wrong.

This *Guide* suggests a number of ways to use a spinning table to explore circular motion. The same equipment can also serve as a spindle, as a color wheel, or as a surface on which to make paintings. If the children are free to use the spinning table by itself and in combination with the rest of the resources of the classroom, they will find dozens of new uses for it.

Grade Level and Scheduling

SPINNING TABLES has been taught in kindergarten through third grade. The unit has worked best as an extra activity for children to come to again and again as their curiosity moves them. Using SPINNING TABLES in this manner, the class can explore with the equipment over the entire school year. Some children may quickly lose interest; others will come back to the materials time and time again.

If you prefer to approach the unit as a whole-class activity, you should plan on spending six to eight weeks at it. Each child will need a chance to work with the tables at least twice a week, either by himself or with a small group, so that all the children will have some feeling for the activities discussed when the class comes together to talk about experiences.

Since there will be two spinning tables in your classroom (see "Equipment"), a number of children can work with them at a time. It is helpful to have the tables set up in a definite place where a child can come to them in his free time or when it is his turn to use a table. Try to arrange a schedule so that all the children who wish to can have an opportunity to work with the spinning tables. If the tables are available only after the children have finished assigned work, then usually only the quickest and best-organized children will have a chance to work with the tables.

A Note on Using the Guide

Detailed instructions for teaching formal lessons with spinning tables were purposely not included in this *Guide*. Children learn a great deal

just from playing with the equipment. A number of activities are described to help you suggest new avenues of exploration to children who need inspiration from time to time. There is no prescribed sequence to these activities, nor are the activities an indication of all possible investigations with the tables. You and the children will probably think of many other things to do. The more time you spend working with the spinning tables yourself, the more you will be able to help the children in their own explorations.

Equipment

For the activities in this *Guide*, you will need the table equipment and accessories which are supplied in the *Kit*.* Your students will find that other objects—such as pencils, blocks, string, and cardboard—can be used with the tables in rewarding ways.

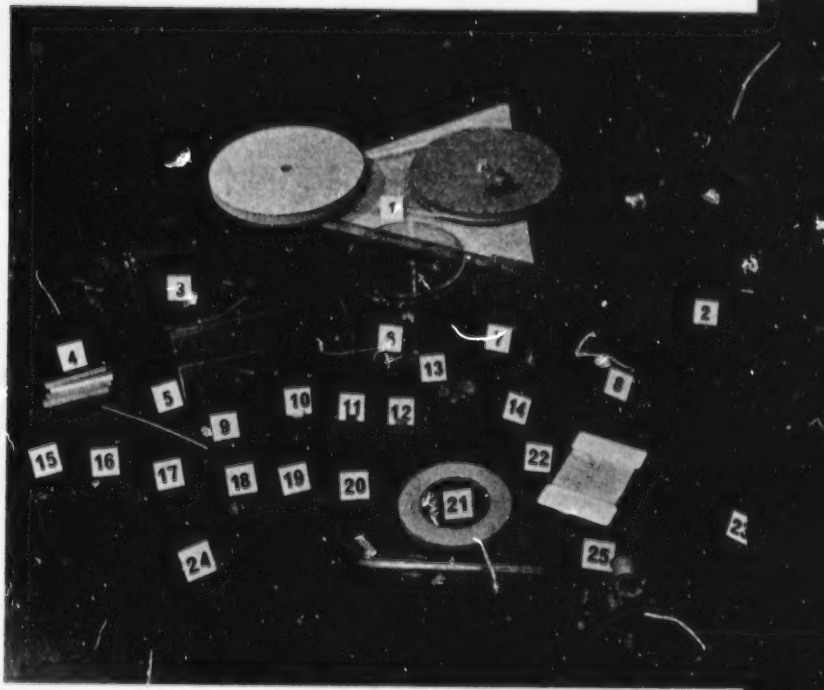
Table Equipment

2 drive assembly bases with "O" ring drive belts
2 pegboard disks
2 smooth chalkboard disks

*Available from Webster Division, McGraw-Hill Book Company, Manchester Road, Manchester, Missouri 63011

Accessories

1 package colored chalk
1 rectangular container with cover
1 round container with cover
1 compartmented clear plastic container with cover
¼ lb modeling clay
4 rubber bands
2 wood cubes
2 steel cubes
2 aluminum cubes
8 top halves of golf tees
1 package food coloring
1 roll masking tape
6 sheets carbon paper
1 plastic tube
2 rubber stoppers for tube



Additional Materials Needed

paper towels
water
salad oil
various powders (such as sugar, salt, flour)

activities

Introducing Spinning Tables

SPINNING TABLES has been introduced in classrooms in many ways. Some of the most exciting classes have occurred when the teacher has presented the equipment and then let the children experiment freely with the tables for the first few classes.

You would do well to do some preliminary work with a spinning table yourself. If you read past the introduction without trying the equipment, you will be missing some enjoyable surprises and many valuable experiences.

The spinning table, the smooth chalkboard disk, and chalk provide enough stimulus for most children to begin work. The first thing they usually do is to see how fast they can spin the table. The children will want to see the marbles, cubes, or other objects that are available fly off the table wildly. There are a number of ways in which you may want to handle this activity. Some teachers have put the spinning tables inside large containers, to catch the flying objects (see page 11).

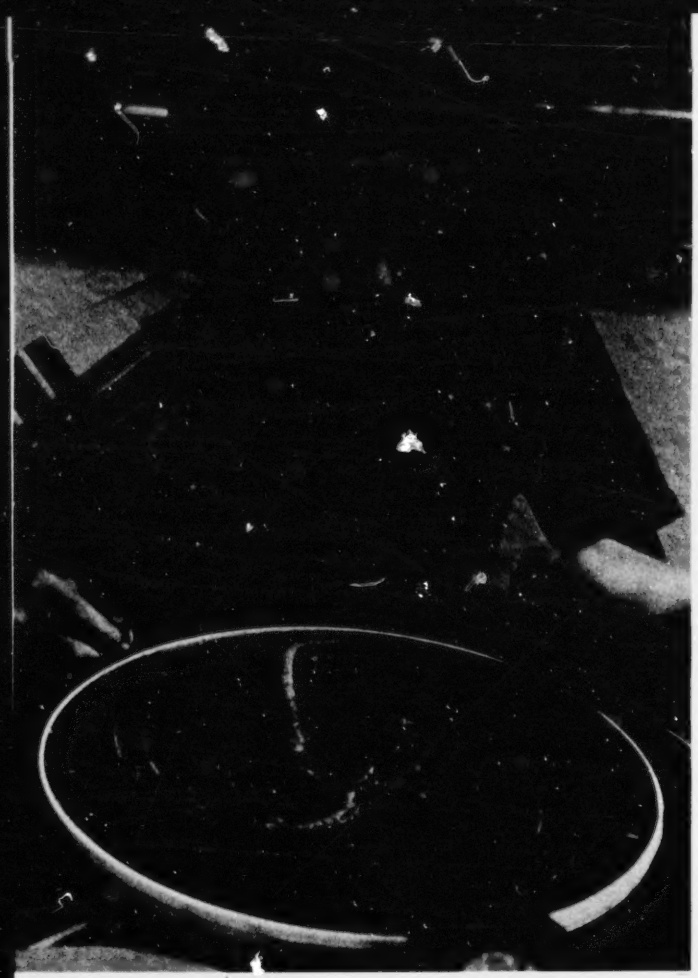
Chalk Activities

For these activities you will need the smooth chalkboard disk colored chalk, and a damp cloth or eraser. It is easy to make comparisons between the results if you use a different color chalk each time you draw on the chalkboard.

Allow the children enough time to become familiar with the table and to work out their initial desire to spin the tables on and on. If they seem to have come to a dead end on their own, you can stimulate further activity with questions such as these:

Can you draw an "X" on the disk, with just two strokes, while the table is spinning?

If you make a mark at the center of the disk, what happens to it when you spin the table?



Can you draw a circle on the disk while it is not moving which will look the same when the table is spinning?

Once such questions have been offered to a few groups of children, they can pass them on to other groups.

Children are usually fascinated by the patterns which emerge if they either draw on the disk while the table is spinning or draw on the still disk and then spin the table. Some children have continued these activities for days, while a few are ready for something more after a short time.

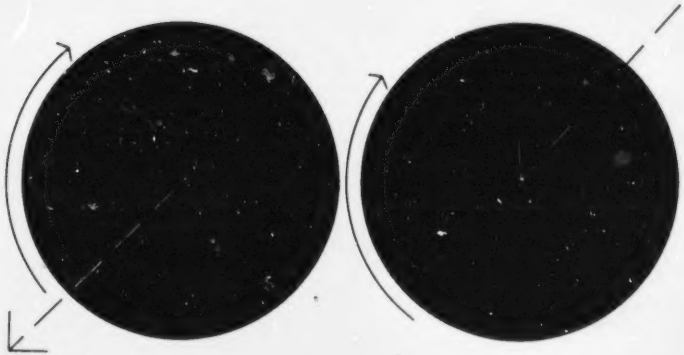
Predicting can be a good starting point for any exploration. When your students begin to carry through some of their own investigations, encourage them to predict in advance what they expect will happen.

You might ask them to draw on a piece of paper or on the chalkboard disk what they think will happen if they do certain things and then to compare their predictions with the results. Here are several examples.

1. *Here is a top view of the table spinning clockwise. Can you predict what kind of pattern you will get if you use the chalk to draw a line from the center of the disk to the edge as the table spins? With a little practice, you should be able to make a light stroke with the chalk so that the table won't slow down too*

much. (The dotted line in the diagram represents one possible motion of your hand.) Draw on this diagram what you think the chalk line will look like after the table stops. What would happen to the pattern if you drew your hand across the disk more slowly but kept the table spinning at the same rate? Try drawing this prediction on the same diagram.

Seldom does anyone predict the pattern correctly. One girl was convinced, when she saw the result, that her hand must have moved according to the pattern shown on the disk. Her surprise led to an interesting class discussion on how she could keep the motion of her hand straight. Eventually, a couple of classmates decided to hold a yardstick horizontally about an inch above the table for her to use as a guide. Once the children were convinced that her hand's motion was straight, they tackled the problem of what caused the strange pattern.



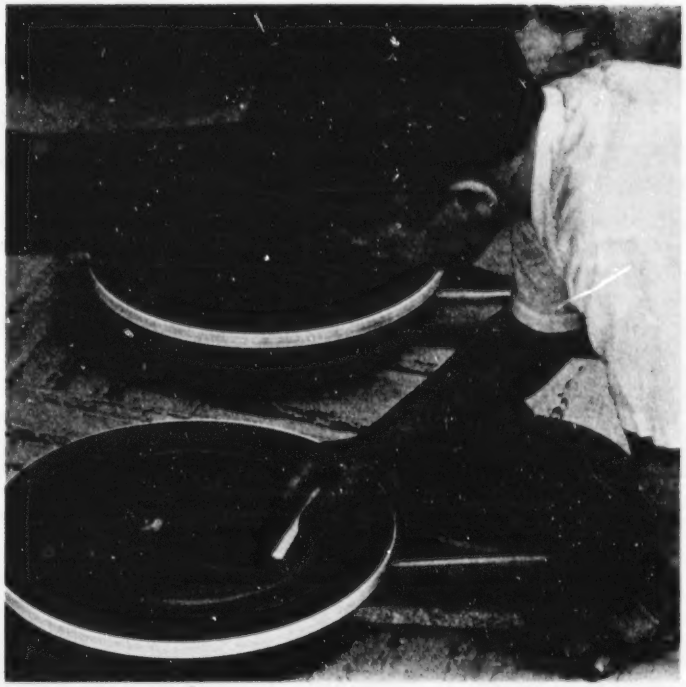
2. *What pattern will you get if the table is spinning very slowly? Draw your line across the disk at the same speed as in the first activity. Will spinning the table in the opposite direction give different results? Try it.*

Once a spiral has been introduced into the class, the children may be fascinated for quite some time. If the spinning disk has a spiral pattern on it and you stare at the center of it until the table stops spinning, you will probably experience an eerie optical effect. Try spinning the table in the opposite direction as well.

3. *Predict what pattern you will get if you use the chalk to draw a straight line all the way across the spinning disk. What will happen if you spin the table in the opposite direction? Will the patterns in both situations be alike?*

4. *Can you draw a circle on the disk while the table is spinning?*

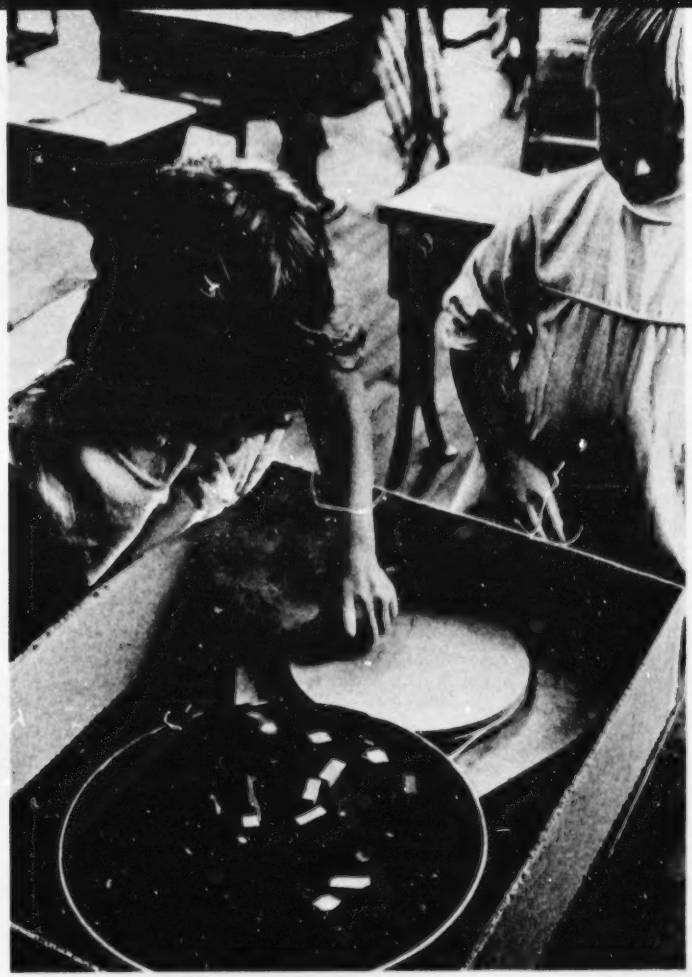
Children enjoy drawing interesting patterns on the disks with chalk of different colors. Elaborate designs turn into fantastic patterns when spun, but so do random lines. If you draw on the disk while the table is spinning, you can have no idea what the design will look like when the table stops.



I used the spening table and you can make a timetonel by takeing you'r hand sloulee away from the meatel of the Board.

THE SPINNING TABLE

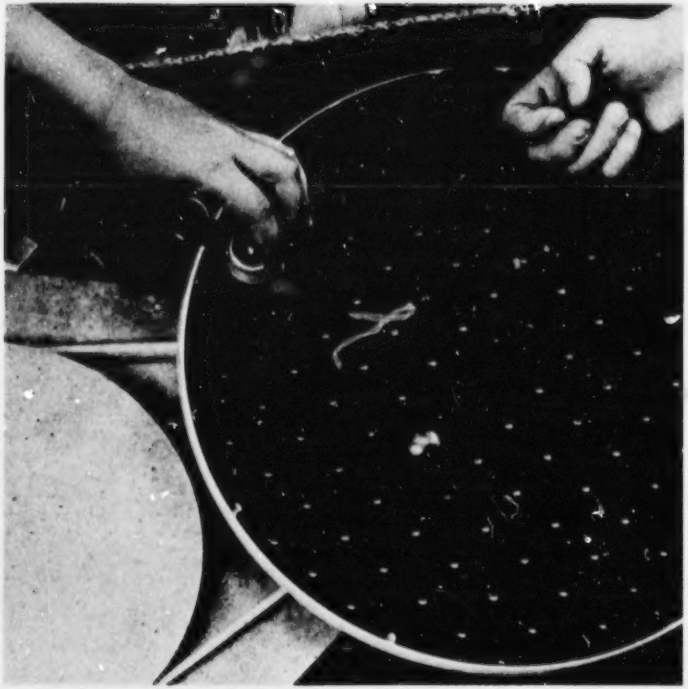
I like the Spinning table because you can try to make something It dosn't matter if it looks bad because when you stop it it looks very funny thats the fun part of it.



Marbles and Cubes

You will need the pegboard disk, the marbles, and the cubes for these activities. Any other object that can be placed on the table—such as pencils, pieces of chalk, or paper clips—can also be spun off.

For these activities, some teachers have found it desirable to put each table in a large box with low sides. The box then catches the flying objects so that they don't disturb the class.



Select four marbles which are different in size and/or weight. Place them at random in the holes on the pegboard. Spin the table slowly at first, then faster and faster. Do you think all the marbles will fall off at the same time? What happens?

Children usually predict correctly that the marbles will fall off the table as it spins fast. They often guess that all the marbles will fall off together.

Try another pattern of marbles. Before you spin the table again, make a prediction of the order in which the marbles will fall off when the table turns. As you try various patterns, your predictions will get better.

What makes a difference in how the marbles fall off?

Can you make a set of rules that will help you to predict?

Is it the distance from the center, the size of the marble (the way it sits in the hole), the weight of the marble, or a combination of these that affects what a marble will do in each situation?

When making a rule, children often decide that weight is the only important factor and that the heavier the object is, the longer it stays on the spinning table. If you draw concentric circles with chalk on the pegboard disk as it spins, you will be able to find equal distances from the center more easily.

Can you put a marble somewhere on the pegboard disk so that it will not fall off?

Does it matter which marble you use?

One first grader put the big steel marble in the middle hole, and when it didn't fall off, she was not surprised. "The heavy marble will never fall off!" she claimed. Later, she was surprised by what happened when the teacher placed a small light marble in the middle hole and the steel marble off center.

Some children enjoy playing "catch" with marbles using the smooth chalkboard disk. Two children sit with the table between them while a third child turns it. The object is to roll the marble across the spinning table to the other player.

With the table spinning, place the large steel marble in the center of the smooth disk.

What happens?

What will happen if you try this with other marbles?

The path of a marble rolling on a spinning table is worth looking at. You can record the path, using carbon paper, the steel marble, and a soft sheet of paper. As the marble moves across the table, it leaves a track on the paper. Recording the path with carbon paper works best with the pegboard disk.

Place some cubes that are of different weights, shapes, and materials at random on the smooth chalkboard disk. Spin the table.

Can you predict which block will fall off first? . . . second? . . . last?

Can you make rules for the order in which the blocks will slide off? Are these rules the same as those you made for the marbles?

Place one cube about an inch from the center of the smooth chalkboard disk. Spin the table, and watch the cube's motion as it slides off.

Is the cube sliding straight out from the center? . . . out and forward? . . . out and backward?

Another way to observe the path that an object makes when it slides off the table is to use a short pencil, stick, or piece of chalk. Place it near the center, and spin the table.

Does the object slide straight out from the center?

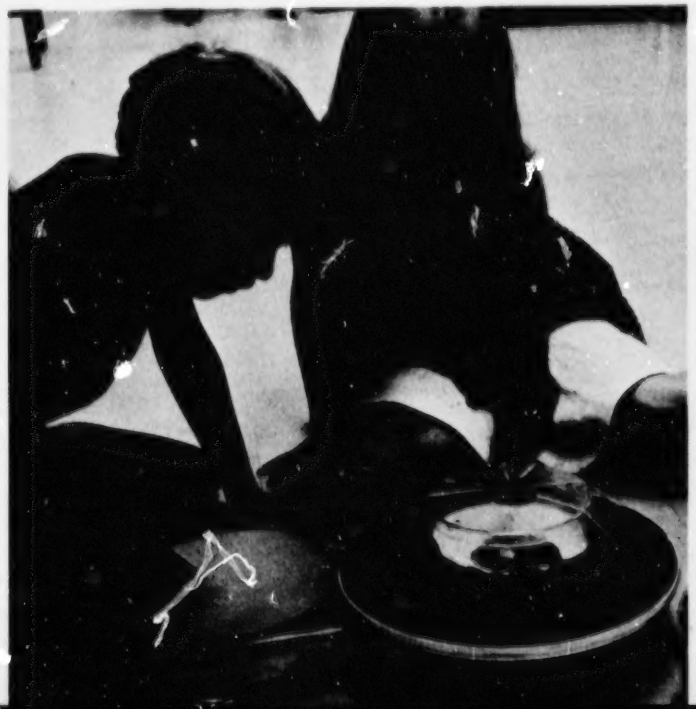
If you draw a straight line through the center of the disk before you spin the table, it is easier to see the paths taken by any of the objects when they slide off.

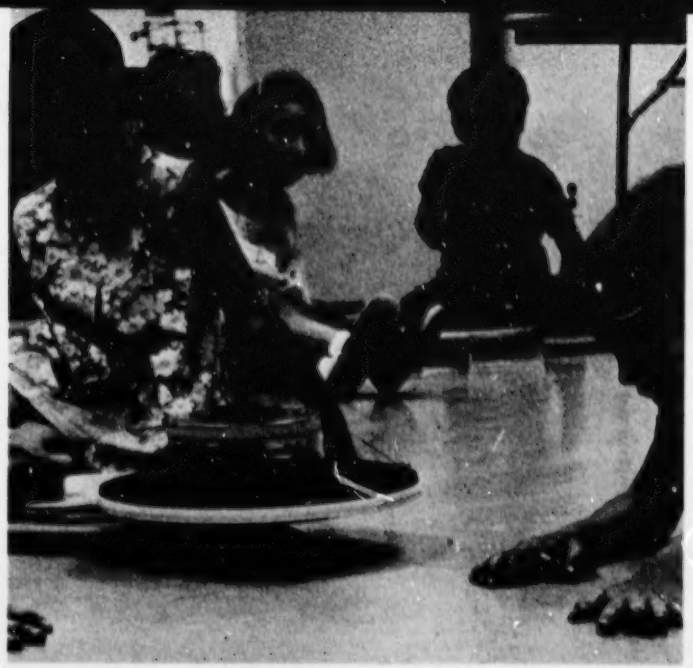
Powders and Liquids

Investigations with powders and liquids can be messy. All containers should be covered, and masking tape should be used to seal the edge between the cover and any container with liquid in it. Fasten the container securely on the table with the modeling clay, a rubber band, and the tops of golf tees supplied in the *Kit*.

You may save yourself a lot of cleaning up if you start these activities by challenging the children to secure the empty container to the table so that it won't fall off. A few trials with an empty container usually produce more effective ways of fastening the containers onto the tables.

Suppose you start with powders. Pour a mound of salt into the round container, and seal the lid. Fasten the container to the pegboard disk.





Before you spin the table, can you predict what will happen to the salt as the container is spun faster and faster?

Will the mound of salt look the same after the table has stopped spinning?

Does it matter where the container is located on the table?

Does it matter where the salt is initially placed in the container?

Does it matter what shape of container you use?

The children may have to repeat any one activity over and over before they are convinced that there is any regularity in the patterns produced.

Liquids produce results very similar to powders. Many of the same questions apply.

What do you think will happen if you use either the round or the rectangular container full of water?

When you place the round container filled with water in the middle of the table and spin it, the water acts differently than it did when you spun the rectangular container in the middle of the table. You can get a better look at what happens if you place a drop of food coloring in the container of water before you seal it and set the container carefully in the middle of the table. Try the same thing with the rectangular container for comparison.

What happens when you spin the table?

Set up the compartmented container so that one of its ends is at the center of the pegboard disk. Fill each compartment about one-quarter full of water. Make sure the container is secured to the pegboard disk.

Using an ink marker or a grease pencil, mark on the container itself where you think the water levels will be when you spin the table.

What happens?

Does the speed at which you spin the table make a difference?

If you set the container in a different place on the table, are the levels the same when you spin it as they were before?

The Tube

Seal the bottom of the tube with a rubber stopper and fill the tube with water to 1 inch below the top. Cap the top of the tube.* You may find that your students are fascinated by the tube itself. Children get interested in just watching the air bubble go up when they flip the tube vertically. One group of second graders spent quite a long time talking about such questions as –

Why do bubbles go up?

What other things go up?

Why do rocks go down?

The tube can be secured onto the pegboard disk with a rubber band.

*Read the following section "Using the Tube" before you begin these activities.

What does the bubble look like when the tube is attached to the disk?

Where is the bubble?

Can you tell if the table is level?

What do you think will happen to the bubble as the table is spun?

Will it change its shape?

Will it change its position?

Will the speed of the table make a difference?

If you start with the table tilted at an angle, as in the diagram, what do you think will happen to the bubble when the table is set in motion?

What will happen if you fasten the tube off center to a level table and spin it?

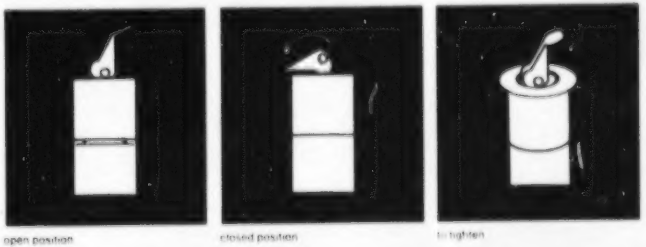
What will happen if you do this with a table that is not level?

What do you think would happen if you put some dirt in the tube, filled it with water, and then spun the table?

Using the Tube

To tighten the tube stopper, turn the thumb lever on the top in a clockwise direction. Be careful not to tighten it too much. With the thumb lever in the open position, the stopper should not be tight in the tube, since it will distort the tube when it is snapped closed. (If this happens, cut the distorted end off with scissors.) Because of the shape of the thumb lever, many people have a tendency to try to close the stopper the wrong way (see the correct way in the diagrams). With the stopper sealed, you should be able to read "Press here" on the thumb lever.

The sides of the tube will collapse inward if the tube is kept filled and sealed overnight. At the end of each class, check to make sure the tube has been emptied. If it does collapse, you can return the tube to its original shape by filling it with hot water, waiting a minute or so, emptying it, and allowing it to dry in a vertical position.



A Final Word

The preceding pages have outlined a number of activities which children can pursue with the spinning tables. These have all worked fairly well in a number of classes.

Individual classes, groups, and children have devised further activities. Some of these may appeal to you.

Many things rotate. Your class might enjoy listing rotating objects that they have seen—tires on an automobile, merry go-rounds, rotating playground equipment, beaters on an electric mixer, phonograph turntables, piano stools, water going down a drain, and so on.

Place a piece of paper on the spinning table, and draw on it or drop paint on it to make exciting designs. If the paper is thoroughly soaked first and watercolors are then used, a special effect is produced. (This activity can splatter a remarkable amount of paint over a wide area!)

One group of first graders made the two spinning tables into spindles by mounting a stick in the center of each pegboard disk and then rolling pieces of string from one to the other. Does this work if one of the sticks is off center?

Another group made cartoon movies by mounting a cardboard rim with slits on it around the edge of the table and drawing a series of simple pictures on the inside of the cardboard.

Children can prepare all kinds of color wheels by taping pieces of colored paper on the tables.